ASSESSMENT OF STEREOTYPIC AND SELF-INJURIOUS BEHAVIOR AS ADJUNCTIVE RESPONSES

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Certain responses of both humans and nonhumans appear to be maintained indirectly by intermittent reinforcement schedules and have been referred to collectively as adjunctive behavior. Although basic research has examined adjunctive behavior extensively, relatively few studies have been conducted with humans, particularly those with developmental disabilities who often engage in frequent and varied stereotypic behavior. This study assessed possible adjunctive characteristics of self-injurious and stereotypic behaviors using a multielement design containing two types of control conditions. Four subjects who engaged in both self-injurious behavior and stereotypy participated after variables maintaining their self-injury were identified via functional analyses. Each day, subjects were exposed to three 15-min sessions in random order: (a) noncontingent presentation of food on a fixed-time schedule (e.g., FT 30 s), (b) a massed-reinforcement (food) control, and (c) a no-reinforcement control. A variety of fixed-time schedules were examined during different experimental phases. Results of this preliminary study suggested that self-injury was not induced by intermittent reinforcement schedules, whereas the stereotypic behavior of some individuals showed characteristics of adjunctive behavior. The importance of research on adjunctive behavior and suggestions for future studies are discussed.

DESCRIPTORS: adjunctive behavior, functional analysis, self-injurious behavior, stereotypic behavior, schedule-induced behavior

Results of basic research on adjunctive or schedule-induced behavior¹ indicate that certain responses in nonhumans increase in frequency when exposed to intermittent reinforcement. These behaviors are not maintained directly by the reinforcement contingency but may have reinforcing properties themselves, and the value of these automatic consequences appears to increase in the

presence of the reinforcement schedules (Falk, 1971).

Most research with nonhumans has examined the effects of intermittent food delivery on a variety of responses, including polydipsia (Falk, 1961), aggression (Hutchinson, Azrin, & Hunt, 1968), wheel running (Levitsky & Collier, 1968), air licking (Mendelson & Chillag, 1970), pica (Roper & Crossland, 1982), defecation (Wylie, Springis, & Johnson, 1992), and drug administration (Lang, Latiff, McQueen, & Singer, 1977). Adjunctive behavior, which is not merely adventitiously reinforced behavior, occurs when reinforcement is delivered contingent on a free-operant response, such as lever pressing, or when delivered on fixed-time (FT) schedules independent of behavior. The re-

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¹ The terms *adjunctive* and *schedule induced* are used synonymously here and refer to both facilitative and interim activities, as described by Staddon (1977).

sulting increase in responding is generally excessive and, in some cases, maladaptive.

The potential relevance of these findings to human behavior has not gone unnoticed. Epling and Pierce (1983) called for extensions of research on adjunctive behavior to problems such as drug addiction, aggression, and anorexia nervosa. Rast, Johnston, Ellinger-Allen, and Drum (1985) noted several similarities between adjunctive behavior in nonhumans and rumination in individuals with developmental disabilities. Foster (1978) proposed a variety of potential candidates for human adjunctive behavior, including beard stroking, nail biting, and other self-stimulating rituals. However, he found no studies on adjunctive or schedule-induced behavior in the *Journal of Applied Behavior Analysis* (1968–1977) compared to 63 studies in the *Journal of the Experimental Analysis of Behavior* (1958–1977), and concluded that adjunctive behavior might be an underreported phenomenon in applied behavior analysis.

Nevertheless, the results of research on human adjunctive behavior reported elsewhere suggest that a variety of responses, including drinking (Porter, Brown, & Goldsmith, 1982), eating (Fallon, Allen, & Butler, 1979), fidgeting (Clarke *et al.*, 1977), pacing (Muller, Crow, & Cheney, 1979), smoking (Cherek & Brauchi, 1981), grooming (Granger, Porter, & Christoph, 1984), and vocalization (Porter *et al.*, 1982), appear to occur as adjunctive behavior in some subjects. Fewer studies have examined problem behaviors of individuals with developmental disabilities as potential adjunctive behaviors (Emerson & Howard, 1992; Scherer & Sanger, 1981; Wieseler, Hanson, Chamberlain, & Thompson, 1988).

Results of most studies with humans have differed somewhat from those with nonhumans. For example, human subjects usually display immediate induction (*i.e.*, adjunctive behavior occurs during the subject's first exposure to the reinforcement schedule), whereas nonhuman subjects typically require several exposures. Some studies with humans also failed to obtain the characteristic temporal patterning of adjunctive behavior found with nonhumans (*e.g.*, Fallon *et al.*, 1979; Granger *et*

al., 1984). Nonhuman subjects tend to exhibit the highest rates of adjunctive behavior immediately after reinforcement delivery, with a gradual decrease in response frequency across the interreinforcement interval.

These differences may have resulted from methodological variation between studies with humans and those with nonhumans. Compared to research with nonhumans, studies with human subjects have used atypical reinforcing stimuli, such as access to games, puzzles, or tasks (*e.g.*, Fallon *et al.*, 1979; Lasiter, 1979; Wallace & Singer, 1976); have failed to examine temporal response patterns (*e.g.*, Porter *et al.*, 1982; Scherer & Sanger, 1981); and have used incomplete or idiosyncratic baseline (control) conditions (*e.g.*, Clarke *et al.*, 1977; Wieseler *et al.*, 1988). Roper (1981) provided extensive discussion of baseline considerations, arguing that the study of schedule-induced behavior must include both massed-reinforcement and no-reinforcement control conditions in conjunction with intermittent reinforcement schedules. During massed-reinforcement sessions, the same amount of reinforcement provided during the intermittent reinforcement sessions is freely available to the subject at the start of the session. This control is necessary because the mere presence of the reinforcer, and not its intermittency, could elicit the response under investigation. Rate of behavior in the massed-reinforcement condition must be lower than that under intermittent reinforcement to demonstrate the occurrence of adjunctive behavior. Even if this requirement were satisfied, however, behavior could still occur at a higher rate in the absence of reinforcement (*i.e.*, in the absence of a competing consummatory response). Thus, response rate in a no-reinforcement condition also must be lower than that during intermittent reinforcement. All sessions should be of similar length so that both session duration and amount of reinforcement per session are equated. Roper further noted that a commonly used control condition, fixed-ratio (FR) 1, is undesirable for several reasons. First, it does not equate both session duration and number of reinforcers per session between the intermittent schedule and its control. In addition, the FR 1 schedule allows

subjects to engage in continuous consummatory behavior, thus limiting the time available for adjunctive responding. Thus, the FR 1 baseline fails to equate both instigation (frequency of reinforcement) and opportunity (availability of the response) during baseline and experimental conditions (Timberlake, 1982).

Most studies on adjunctive behavior in humans have not included the types of controls described above. During some baseline conditions, subjects listened to tapes on various topics unrelated to tasks provided during intermittent reinforcement (e.g., Wallace & Singer, 1976) or watched videos explaining the rules of the task (Clarke et al., 1977). Other studies exposed subjects to FR 1 or massed-reinforcement baselines in the absence of no-reinforcement baselines (e.g., Granger et al., 1984; Scherer & Sanger, 1981; Wieseler et al., 1988) or to no-reinforcement baselines in the absence of massed-reinforcement baselines (e.g., Kachanoff, Leveille, McLelland, & Wayner, 1973; Muller et al., 1979).

Such incomplete baseline controls allow alternative interpretations of the findings in these studies. For example, Scherer and Sanger (1981) examined adjunctive stereotypy (e.g., gazing at fingers, flicking fingers, head weaving, heaving breathing) in 3 speechless psychotic children using an FR 1 condition for imitating vocalizations, a massed-reinforcement condition, and an FT 60-s condition. Rates of stereotypy were higher during the FT 60-s condition than during the two control conditions for 1 subject. Wieseler et al. (1988) examined stereotypic behaviors in 3 subjects with developmental disabilities by exposing them to an FR 1 schedule and several fixed-interval (FI) schedules (15 s, 90 s, 180 s) for placing objects in a container. Rates of stereotypy increased as the interreinforcement interval increased. Despite these findings of apparent adjunctive stereotypy, the higher rates of stereotypy as schedule intermittency increased could have resulted from greater opportunity (availability of the response).

In an attempt to control for this problem, Emerson and Howard (1992) examined schedule-induced stereotypy in individuals with developmental

disabilities by comparing intermittent reinforcement (FT, FI, or differential-reinforcement-of-low-rate schedules) to both massed-reinforcement and no-reinforcement baselines. Their criteria for a demonstration of adjunctive behavior were mean rates of responding during intermittent reinforcement that were (a) at least 150% greater than that during no reinforcement or (b) at least 150% greater than the mean rates during both no reinforcement and massed reinforcement. Using the latter criterion, the authors found evidence for schedule-induced stereotypy in 5 of the 8 subjects. Further, two topographies of stereotypy meeting this criterion showed the temporal patterns characteristic of adjunctive behavior during interreinforcement intervals.

Although the Emerson and Howard (1992) study demonstrated clear improvements in methodology compared to previous research on adjunctive behavior in humans, the results were limited in two respects. First, neither session duration nor number of reinforcers available was equated during the intermittent reinforcement and control sessions, directly influencing both instigation and opportunity (see Timberlake, 1982). More important, the massed-reinforcement sessions were terminated as soon as subjects consumed all the food items, limiting their opportunity to engage in stereotypy during these sessions.

Despite these and other problems noted above, studies on human adjunctive behavior have made a significant contribution to an area generally ignored by applied researchers. The possibility of adjunctive behavior in humans, particularly individuals with developmental disabilities, should be examined to further our understanding of environment-behavior relations. Combined with functional analysis approaches to assessment (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982), systematic examination of adjunctive behavior would provide a more complete account of such disorders as self-injury, aggression, and stereotypy.

As the above review suggests, there is little consensus regarding the appropriate methodology for studying adjunctive behavior. Research with both humans and nonhumans indicates that assessment should include controls of reinforcement (massed

delivery), extinction (no reinforcement), number of reinforcers, and response availability (session time), as well as an efficient experimental design. An assessment of adjunctive behavior should also include an analysis of temporal response patterns to help to distinguish schedule-induced behavior from other types of behavior that can occur during periodic reinforcement schedules (Staddon, 1977).

The purpose of this study was to determine if self-injurious behavior (SIB) and stereotypy² showed adjunctive characteristics when individuals with developmental disabilities were exposed to several reinforcement schedules within a multielement design that contained the above control conditions. Although stereotypy has been examined in previous studies on adjunctive behavior, SIB has not yet been considered in either basic or applied research. Intuitively, stereotypy seems to be a more likely candidate for schedule induction because of its similarity to adjunctive behavior in nonhumans. Adjunctive behavior appears to produce its own reinforcers (Falk, 1971), a characteristic that often distinguishes stereotypy from SIB in humans. That is, SIB is often maintained by social consequences, such as attention from others or removal of instructions, whereas stereotypic behavior often appears to be maintained by automatic or sensory reinforcement (Baumeister & Forehand, 1973). This study attempted to determine whether SIB can be induced by intermittent reinforcement schedules and, further, if this behavior must be maintained independent of social consequences to occur as adjunctive behavior.

METHOD

Subjects and Setting

Four individuals who engaged in self-injurious and stereotypic behaviors participated. All were diagnosed with severe or profound mental retardation and lived in a public residential facility for persons with developmental disabilities. They had been referred to a day-treatment program for SIB located

on the grounds of the facility. Subject characteristics (ages, topographies of SIB and stereotypy, and medications) are shown in Table 1. Stan, Peter, and Stacey had some receptive but no expressive language skills. Mitch had some receptive and expressive language skills. None of the subjects had sensory or physical impairments except Stacey, who was blind, and none of the subjects had a medical diagnosis suggesting an organic basis for SIB. All were exposed to functional analyses of SIB prior to entering the study and were selected because they exhibited at least one stereotypic response in addition to SIB. The assessments included four standard conditions (alone, attention, demand, play) that have been used in previous research on the functional analysis of SIB (e.g., Iwata *et al.*, 1982). Results for Stan and Peter indicated that their SIB was maintained by escape from instructions, whereas data for Mitch and Stacey indicated that their SIB was not maintained by social consequences. The subjects' stereotypic behaviors were not assessed with functional analyses. Informally, they were observed to engage in similar levels of stereotypy across a variety of conditions (including those in the functional analysis of SIB). This apparent insensitivity to changes in environmental contingencies, as well as the persistence of responding in the absence of social contingencies, suggested that their stereotypic behaviors were maintained independent of social consequences. Individual sessions were conducted in therapy rooms of the day program. During all sessions, a therapist and/or observer(s) were present in the rooms, which were relatively empty. The rooms contained a table and at least one chair and measured approximately 3.0 m by 4.8 m or 5.7 m by 10.5 m.

Response Measurement and Reliability

SIBs were defined as follows: *head biting*: forceful contact of the hand with any part of the head or face; *body biting*: forceful contact of the hand with any part of the body; and *hand biting*: closure of the teeth on any part of the skin from wrist to fingertips. Stereotypic behaviors were defined as follows: *vocalizing*: producing any audible vocalization, excluding coughs and sneezes; *spit-*

² In this study, stereotypy is distinguished from SIB based on the absence of physical injury as a response product.

Table 1
Subject Characteristics

Subject	Age	Medications	Topographies
Stan	41	Sinequan® (50 mg) Mellaril® (100 mg)	head/body hitting shirt pulling spitting vocalizing
Peter	44	Mellaril® (75 mg)	hand biting body rocking vocalizing
Mitch	44	haloperidol (1 mg)	head/body hitting arm raising vocalizing
Stacey	22	none	head/body hitting hair playing finger playing vocalizing

ting: expulsion of saliva from the mouth; *shirt pulling*: tugging on the shirt at the shoulders or wrist cuffs; *body rocking*: movement of the upper body in a back-and-forth or side-to-side motion; *arm raising*: arm raised with hand above waist level; *finger playing*: movement of fingers against a stationary object in a rapid back-and-forth motion, or contact of at least one finger with a finger on the opposite hand; and *hair playing*: movement of the hand against the ponytail in a back-and-forth motion.

Observers collected data on response frequency (for SIB, arm raising, spitting, and shirt pulling) and percentage of intervals during which a response occurred (for vocalizing, body rocking, finger playing, and hair playing) using a hand-held computer that audibly signaled 10-s intervals. Observers were graduate and undergraduate students who had demonstrated proficiency with this type of data collection prior to the study. Interobserver agreement was assessed during at least 25% of the sessions in each condition. In comparing observers' records, agreement percentages were calculated on an interval-by-interval basis. For frequency measures, the smaller number of responses in each 10-s interval was divided by the larger number of responses, and these fractions were summed across all intervals and divided by the total number of intervals in the session. For interval measures, the

number of intervals in which both observers scored the occurrence of a response was divided by the total number of intervals in the session. Mean interobserver agreement across subjects was 99% for SIB (range, 92% to 100%), 97% for vocalizing (range, 84% to 100%), 98% for spitting (range, 90% to 100%), 98% for shirt pulling (range, 88% to 100%), 95% for body rocking (range, 84% to 100%), 97% for arm raising (range, 93% to 100%), 90% for finger playing (range, 80% to 100%), and 98% for hair playing (range, 91% to 100%).

Experimental Design and Procedures

Prior to the study, subjects' preference for different snacks (e.g., crackers, cookies, sweet tarts) was assessed by presenting each food item to each subject. All items were presented at least 10 times over the course of four sessions. Preference for a particular item was indicated if the subject consumed it every time it was presented. Based on this criterion, six to eight preferred items were identified for each subject. Subsequently, four highly preferred snacks were identified by presenting two preferred food items during forced-choice trials (Fisher et al., 1992). Items selected for the study were those associated with the four highest percentages of approach by the subject during the forced-choice trials. During experimental conditions, all subjects were exposed to three 15-min sessions presented

each day in random order (i.e., multielement format): (a) delivery of food items on a fixed-time reinforcement schedule, (b) massed delivery of reinforcement, and (c) no reinforcement. Each session was followed by a 15-min break.

Fixed-time reinforcement. Several fixed-time schedules were examined during separate phases of the study. Contingent reinforcement schedules, which often involve an instructional context, were not used because they might have elicited behaviors maintained by removal of instructions. During sessions, the therapist sat several feet away from the subject. At predetermined times, the therapist walked over to the subject and placed a small piece of food on a nearby table or chair (within reach of the subject). The therapist walked quickly and did not speak to the subject or provide eye contact at any time. A variety of preferred snacks was presented during each session. Subjects were exposed to the following schedules in different orders: FT 30 s, FT 60 s, FT 120 s, and FT 300 s. In addition to these schedules, Stan was exposed to FT 15 s.

Massed reinforcement. During these sessions, the therapist gave the subject a plate of food items at the start of each session and walked away. No one interacted with the subject at any time during the session. The number of food items provided was equivalent to the number delivered during the fixed-time reinforcement sessions. This amount varied depending on the fixed-time schedule currently in effect. For example, 15 food items were delivered during the massed-reinforcement sessions conducted in the phase examining the FT 60-s schedule.

No reinforcement. No one interacted with the subject during these sessions, and no food items were provided.

Four to six sessions of each condition were conducted during each phase. Visual inspection of the data was used to note trends in the data, and phase changes were made when the presence or absence of adjunctive behavior appeared to be established.

RESULTS

Data were examined in two ways. Response measures in the fixed-time reinforcement sessions were

compared to those in the two control conditions during each phase of the study. If adjunctive behavior seemed apparent (e.g., more responding occurred in the FT sessions than in the control sessions), within-session patterns of responding across interreinforcement intervals of the FT sessions were examined by calculating the mean number of responses (or intervals scored) over an entire session in each 10-s interval following reinforcement delivery.

Stan was exposed to the FT schedules in the following order: FT 30 s, FT 120 s, FT 60 s, FT 300 s, and FT 15 s. Figure 1 shows responses per minute (or percentage of intervals) of SIB and stereotypy in all sessions of each experimental phase. (For all subjects, phases are arranged according to FT schedule length, not order of implementation, with increasing fixed-time intervals from left to right on the figures.) Results of Stan's assessment show no evidence of adjunctive SIB (top panel). Interestingly, Stan had high levels of SIB during some phases (e.g., FT 15 s), although no instructions were presented during this study. This was unexpected because Stan rarely exhibited SIB in any condition but the demand condition of his functional analysis. Some evidence of adjunctive stereotypy was found. Responses per minute of shirt pulling and spitting (middle two panels) were higher during the FT conditions than during the two control conditions in several phases, particularly the FT 30-s phase. Mean rates of shirt pulling and spitting in the FT 30-s sessions were 297% and 300%, respectively, of the mean rates in the massed-reinforcement sessions and 1,017% and 453%, respectively, of the mean rates in the no-reinforcement sessions. Stan also exhibited more vocalizing during the FT 120-s sessions than during the control sessions of this phase (bottom panel). The mean percentage of vocalizing the FT 120-s sessions was 295% of the mean percentage in the massed-reinforcement sessions and 505% of the mean percentage in the no-reinforcement sessions. The decrease in vocalizing during the last 2 days of this phase could indicate that this adjunctive behavior would not have been maintained following repeated exposures to periodic reinforcement.

Figure 1. Responses per minute of SIB, shirt pulling, and spitting, and percentage of intervals of vocalizing during the three daily conditions of Stan's assessment.

Patterns of responding across interreinforcement trials of Stan's FT sessions are shown in Figure 2. Both FT 30-s and FT 60-s sessions were included in the analysis for shirt pulling and spitting. Although the strongest evidence of adjunctive behavior occurred during the FT 30-s phase, the interreinforcement trials seemed too short to reveal noticeable trends. The top panel shows the mean number of shirt pulling and spitting responses per session in the FT 30-s condition during consecutive 10-s intervals following reinforcement delivery. Both behaviors occurred more often in the second 10-s interval, with a decrease in responding during the last 10-s interval, immediately prior to reinforcement delivery. Such patterns are not entirely characteristic of adjunctive behavior. The middle panel shows mean shirt pulling and spitting per session in the FT 60-s condition during consecutive 10-s intervals following reinforcement delivery. The two responses showed somewhat different trends across interreinforcement trials. Shirt pulling was highest at the start of the trial and gradually decreased across intervals, whereas spitting increased during the third 10-s interval and then decreased until the next reinforcer delivery. The lower rates of spitting at the beginning of the interreinforcement trial may have been due partly to its incompatibility with food consumption. The bottom panel shows the mean number of intervals with vocalizing per session in the FT 120-s condition during consecutive 10-s intervals following reinforcement delivery. Vocalizing was highest immediately following reinforcement delivery and gradually decreased as the intervals progressed closer to the next reinforcement delivery. Thus, patterns for vocalizing in the FT 120-s phase and for shirt pulling and spitting in the FT 60-s phase are consistent with previous findings on adjunctive behavior and provide support for the occurrence of schedule-induced behavior for Stan.

← condition during consecutive 10-s intervals following reinforcer delivery. Bottom panel: mean number of intervals scored with vocalizing per session in the FT 120-s condition during consecutive 10-s intervals following reinforcer delivery.

Figure 2. Temporal pattern of Stan's stereotypic behaviors during interreinforcement intervals. Top panel: mean number of shirt pulling and spitting responses per session in the FT 30-s condition during consecutive 10-s intervals following reinforcer delivery. Middle panel: mean number of shirt pulling and spitting responses per session in the FT 60-s

Figure 3. Responses per minute (or percentage of intervals) of SIB and one topography of stereotypy for each of the remaining subjects during the three daily conditions of their assessment.

Assessment results for the 3 remaining subjects revealed no strong evidence of adjunctive behavior. Figure 3 shows responses per minute (or percentage of intervals) of SIB and one topography of stereotypy for each subject in the three conditions of each experimental phase. Results for SIB are presented for all subjects because data on adjunctive characteristics of SIB have not, to our knowledge, been published previously. On the other hand, adjunctive stereotypy in individuals with developmental disabilities has been examined in several studies (e.g., Emerson & Howard, 1992; Wieseler *et al.*, 1988). Thus, data on just one topography of stereotypy are displayed for each subject. The selected topographies either showed some characteristics of adjunctive behavior or were representative of the data for the other stereotypic responses included in the assessment.

Peter (top two panels) was exposed to the FT schedules in the following order: FT 30 s, FT 120 s, FT 60 s, and FT 300 s. Results of Peter's assessment showed that SIB rarely occurred during any condition. On the other hand, a slight increase in vocalizing occurred during the FT 60-s sessions relative to the control sessions. The mean percentage of vocalizing in the FT 60-s condition was 184% of the mean percentage in the massed sessions and 262% of the mean percentage in the no-reinforcement sessions, meeting the criterion set by Emerson and Howard (1992) for adjunctive responding. In addition, an analysis of the interreinforcement response patterns for vocalizing across the FT 60-s sessions revealed a descending trend similar to that obtained for Stan's vocalizing.

Mitch (middle two panels) was exposed to the FT schedules in the following order: FT 120 s, FT 30 s, FT 60 s, and FT 300 s. For Mitch's SIB, small but consistent separation occurred between data for the FT sessions and those for the control sessions during the FT 120-s phase. The mean rate of SIB in the FT 120-s sessions was 351% of the mean rate in the massed sessions and 173% of the mean rate in the no-reinforcement sessions. Like the results for Peter's vocalizing, these differences do not appear noteworthy based on visual analysis, although they meet the criterion set by Emerson

and Howard (1992). To explore further the possibility of adjunctive SIB with Mitch, patterns of responding across interreinforcement trials of the FT 120-s sessions were analyzed. His SIB showed no consistent trend across the interreinforcement trials. As demonstrated by the data on arm raising, no evidence of adjunctive stereotypy was found for Mitch.

Results of Stacey's assessment (bottom two panels) revealed no evidence of either adjunctive SIB or stereotypy. Responding during the intermittent reinforcement sessions was rarely higher than responding during both control sessions. In fact, the presence of food items appeared to suppress SIB in several of the phases.

DISCUSSION

This study examined possible adjunctive characteristics of self-injurious and stereotypic behavior in 4 individuals with developmental disabilities. Based on findings of previous research, our assessment included two types of control conditions (both massed-reinforcement and no-reinforcement sessions) and an analysis of responding during interreinforcement trials. In addition, intermittent reinforcement and baseline conditions were equated for session duration and amount of reinforcement, controlling both instigation and availability of the response. Although preliminary, these results suggest that SIB may not occur as an adjunct to reinforcement schedules, whereas adjunctive stereotypy may be exhibited by some individuals.

Results for Stan indicated that some responses (shirt pulling, spitting, vocalizing), but not others (SIB), were sensitive to inducement by intermittent reinforcement. This differentiation was interesting because results of Stan's functional analysis indicated that his SIB was maintained by social consequences (escape from instructions), whereas his stereotypic behaviors appeared to be maintained independent of social consequences. This finding is consistent with previous conceptualizations of adjunctive behavior (Falk, 1971). Assessments for 2 subjects required the removal of specific antecedent and consequent events (*i.e.*, delivery of instructions

and their withdrawal contingent on SIB) known to produce changes in their behavior. By eliminating these variables, the presence of intermittent reinforcement, and not other (potentially confounding) maintaining variables, could account for the increase in SIB observed during FT sessions. Results of Stan's assessment suggest that responses maintained by social consequences do not increase as adjuncts to intermittent reinforcement schedules or that SIB in general does not occur as schedule-induced behavior. Stronger support for either conclusion might have been obtained if Stan had exhibited multiple topographies of SIB with multiple functions: at least one topography maintained by social consequences and at least one topography maintained by automatic consequences.

Peter's SIB was also maintained by social consequences and failed to show adjunctive characteristics. On the other hand, his vocalizing increased somewhat during the FT 60-s condition, meeting the more stringent criterion suggested by Emerson and Howard (1992) for the demonstration of adjunctive behavior (i.e., mean response rate in the intermittent condition exceeded those in *both* control conditions by at least 150%), and showed the typical pattern across the interreinforcement trials. Results of Mitch's assessment also showed only weak evidence of adjunctive behavior that still met this criterion. These findings suggest that a more stringent criterion should be established for the demonstration of clinically significant increases in behavior exposed to intermittent reinforcement. The usefulness of this criterion for the identification of adjunctive behavior is also questionable because the massed-reinforcement condition of the FT 300-s phase for Mitch's arm raising also satisfied this criterion (i.e., mean response rate in these sessions exceeded the mean rate in *both* the FT sessions and the no-reinforcement sessions by at least 150%), yet no explanation for these results is readily apparent.

Nevertheless, temporal patterning of behavior exposed to intermittent reinforcement appears to be an important characteristic in the assessment of adjunctive behavior (Staddon, 1977), and Mitch's SIB failed to show this pattern of responding. Sim-

ilarly, Emerson and Howard (1992) found that three of the five responses meeting their stringent criterion for adjunctive behavior failed to show evidence of this temporal patterning, although three responses meeting the less stringent criterion (i.e., response rate in the intermittent condition exceeded the rate in *only* the extinction condition by at least 150%) did display this characteristic. Nonhumans have also failed to show this temporal patterning in some studies, but only with long interreinforcement intervals after exposure to short intervals had produced adjunctive behavior with this characteristic pattern. The relevance of this temporal patterning to human adjunctive behavior should be examined more closely, and conditions that would or would not be expected to produce this characteristic should be delineated. At best, evidence for adjunctive SIB remains inconclusive for Mitch.

Results of Stacey's assessment showed no evidence of either adjunctive SIB or stereotypy. Like Mitch, all of Stacey's responses were maintained independent of social consequences. These findings suggest that SIB is not likely to show strong characteristics of adjunctive behavior, regardless of whether the SIB is maintained by social or nonsocial contingencies. These results also suggest that not all individuals who engage in stereotypic behaviors will necessarily exhibit adjunctive behavior and that similar responses exhibited by different subjects may not always be schedule induced. Stan, but not Mitch or Stacey, exhibited adjunctive vocalizations. Scherer and Sanger (1981) and Emerson and Howard (1992) obtained similar findings with their subjects. This result is somewhat contrary to findings of studies with nonhumans, who generally exhibit particular, species-specific responses as adjuncts to reinforcement schedules. Such variability among human subjects indicates that specific responses unique to each individual must be included in the analysis of adjunctive behavior.

This study demonstrates just one possible method for the assessment of adjunctive behavior in humans and contains some potential limitations that may have resulted in primarily negative findings. As such, data interpretation and conclusions about the possibility of adjunctive SIB and stereo-

typy should be viewed with caution. For example, results may have been obscured by interaction effects across conditions due to the relatively fast-paced reversals of the multielement design (Hains & Baer, 1989). Adjunctive behavior would not be apparent if high rates of responding induced during intermittent reinforcement sessions carried over into immediately following control sessions. In addition, adjunctive behavior may be less likely to emerge when short periods of intermittent reinforcement are quickly alternated with control sessions. Such interaction effects could be eliminated by alternating an FT-only phase with two separate control phases within a reversal design. However, a complicated series of reversals would be necessary to examine the three experimental conditions (intermittent reinforcement, massed reinforcement, and no reinforcement) across a variety of schedule parameters (e.g., FT 30 s, FT 60 s, FT 120 s). Nevertheless, future studies on adjunctive behavior may find it necessary to sacrifice efficiency for clarity.

Other limitations include the relatively short experimental phases, small number of subjects, and potential order effects. Based on findings of previous research with humans, conditions of extended duration did not appear to be necessary. Indeed, Stan (and possibly Peter and Mitch) exhibited adjunctive behavior during their first exposure to a specific reinforcement schedule, replicating the results of previous studies. However, some individuals may require an extended exposure to periodic reinforcement before adjunctive characteristics of behavior will emerge. Longer experimental phases could have resulted in more significant increases in Peter's vocalizing and Mitch's SIB during the FT sessions. In addition, this type of limited assessment does not examine long-term maintenance of adjunctive behavior, a possibility that should be studied in future research. The order of the different experimental phases may have also contributed to the occurrence or nonoccurrence of adjunctive behavior. Due to the small number of subjects, only two variations in the order of the different schedule parameters were included: FT 30 s, FT 120 s, FT 60 s, FT 300 s, and FT 120 s, FT 30 s, FT 60 s, FT 300 s. Stan (and possibly Mitch) exhibited adjunctive behavior during the first FT condition

of his assessment, suggesting possible order effects. On the other hand, vocalizing for Stan and Peter did not increase relative to the control conditions until the third experimental phase. Nevertheless, the occurrence of adjunctive behavior may be influenced by previous exposure to specific schedule parameters. Future studies could control for such effects by including wider variations in the order of different schedule parameters.

Results may have also been limited by the values chosen for the intermittent reinforcement schedules. These schedules were similar to those used in previous studies with both human and nonhuman subjects. Epling and Pierce (1983) noted that such short intervals may not be applicable to human situations and that adjunctive behavior in humans might occur only with longer time intervals and large reinforcers. However, training programs implemented for individuals with mental retardation tend to involve short reinforcement schedules and small amounts of reinforcement.

Results of the present study may also be limited by the sole use of noncontingent reinforcement schedules. Contingent schedules were omitted from this study because the presence of task requirements might have confounded the results by eliciting responses maintained by escape from instructions. Two subjects engaged in SIB that was sensitive to escape (i.e., negative reinforcement). Although previous studies with both humans and nonhumans have obtained similar results using either contingent or noncontingent schedules, some adjunctive behaviors may be more likely to occur when a response is required for reinforcement delivery.

Findings in this study may also be characteristic of edible reinforcers only. This stimulus was chosen over other types of reinforcing stimuli for several reasons, including its use in previous studies and ease of identification and delivery. Although most basic research studies have examined the effects of intermittent food reinforcement, studies with humans have used a variety of reinforcing stimuli, such as praise, poker chips, and pennies (Kachanoff *et al.*, 1973; Muller *et al.*, 1979; Wieseler *et al.*, 1988). None of these studies reported better success with particular types of reinforcers. For example, Emerson and Howard (1992) used a variety of

stimuli, including snacks, praise, music, and lights, but none differentially produced higher levels of adjunctive behavior in their subjects. The subjects in this study had few identifiable reinforcers, and food items were most representative of the reinforcers delivered in their natural environment. Nevertheless, future studies should examine other types of reinforcers, particularly when edible reinforcers fail to produce adjunctive behavior.

A primary purpose of this study was to stimulate additional interest in the study of human adjunctive behavior by providing a framework that could guide further investigations. Systematic replication of and improvement in the methodology described here will lead to greater knowledge about the prevalence of adjunctive behavior in individuals with developmental disabilities and about the generality of schedule induction to problem behaviors, such as SIB. Among other things, future studies should examine different experimental designs, longer exposure to intermittent reinforcement, a wider variety of schedule parameters, and different types of reinforcers.

These investigations eventually may reveal whether the presence of intermittent reinforcement can produce clinically significant rates of aberrant responding in humans. The possibility of schedule induction is particularly relevant for individuals with developmental disabilities. Programs designed to teach new skills, as well as treatments intended to reduce problem behavior (e.g., the differential reinforcement of other behavior), commonly involve the delivery of food reinforcers on intermittent schedules. These procedures would be counterproductive if they resulted in significant, unexpected increases in maladaptive behavior. When combined with functional analyses of behavior, an assessment of adjunctive behavior would provide a broader account of problem behaviors and aid the development of more comprehensive treatment programs.

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